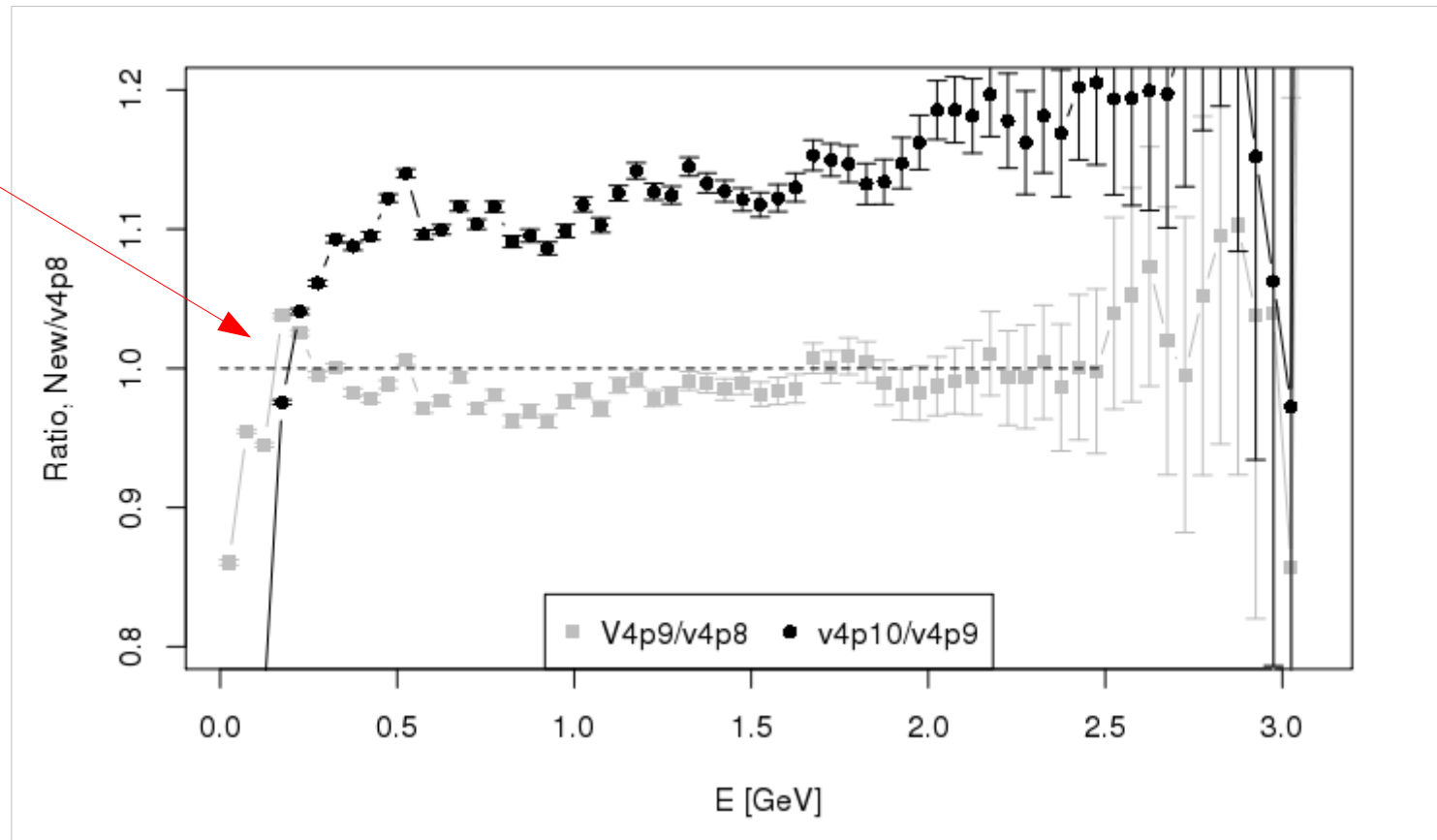# BNB, status, April 14 2016.

Onto more analysis:

About the sharp difference between the ν_μ from π^+ decay, v4p10 vs v4p8

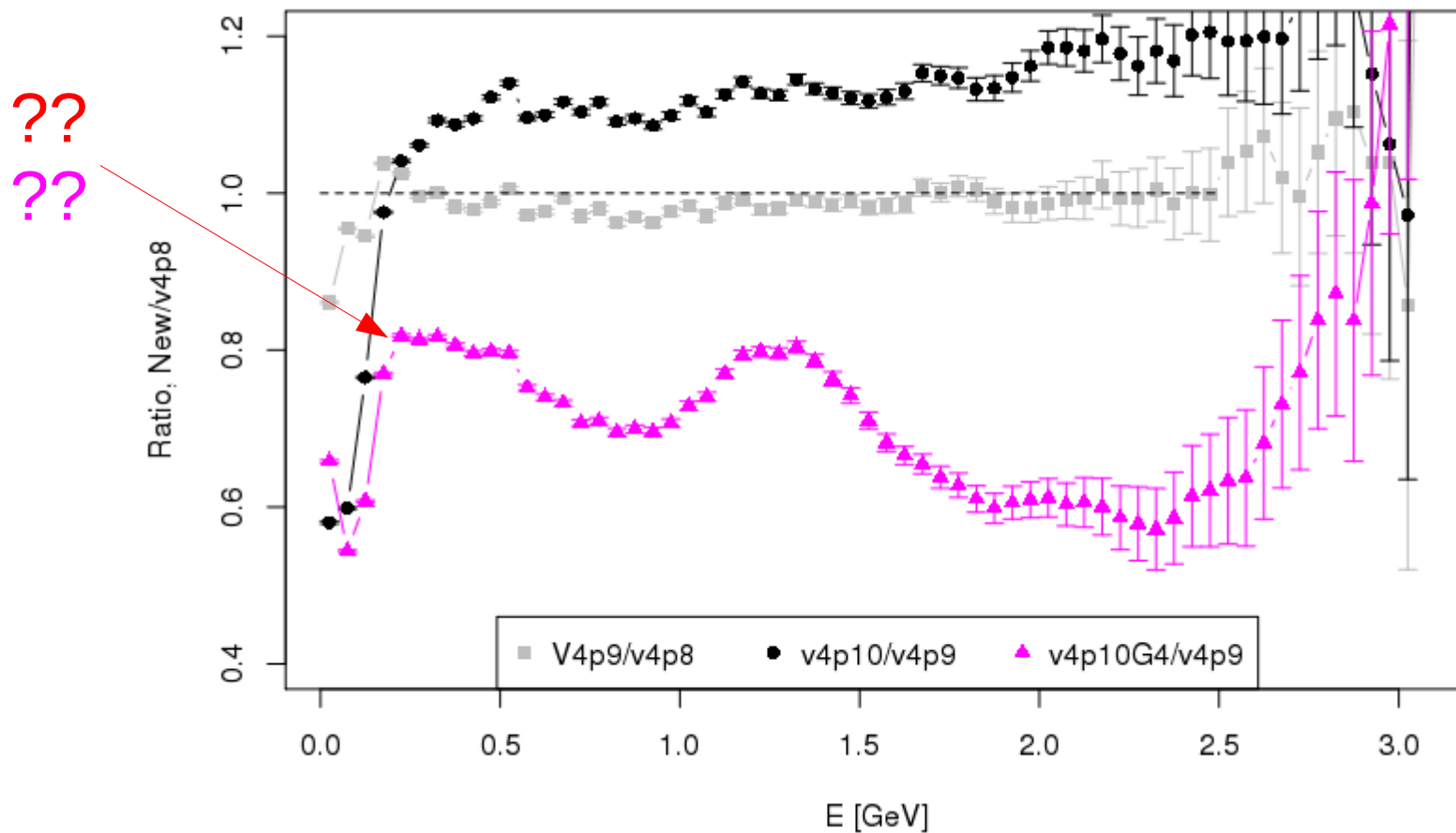# Neutrino flux, from $\pi^+ \rightarrow \mu^+ \nu_\mu$

The ~ 10% at large energy comes from mostly an increase in the targeting efficiency: Less proton elastic scattering, less diffusion.. But what about the low energy deficit?
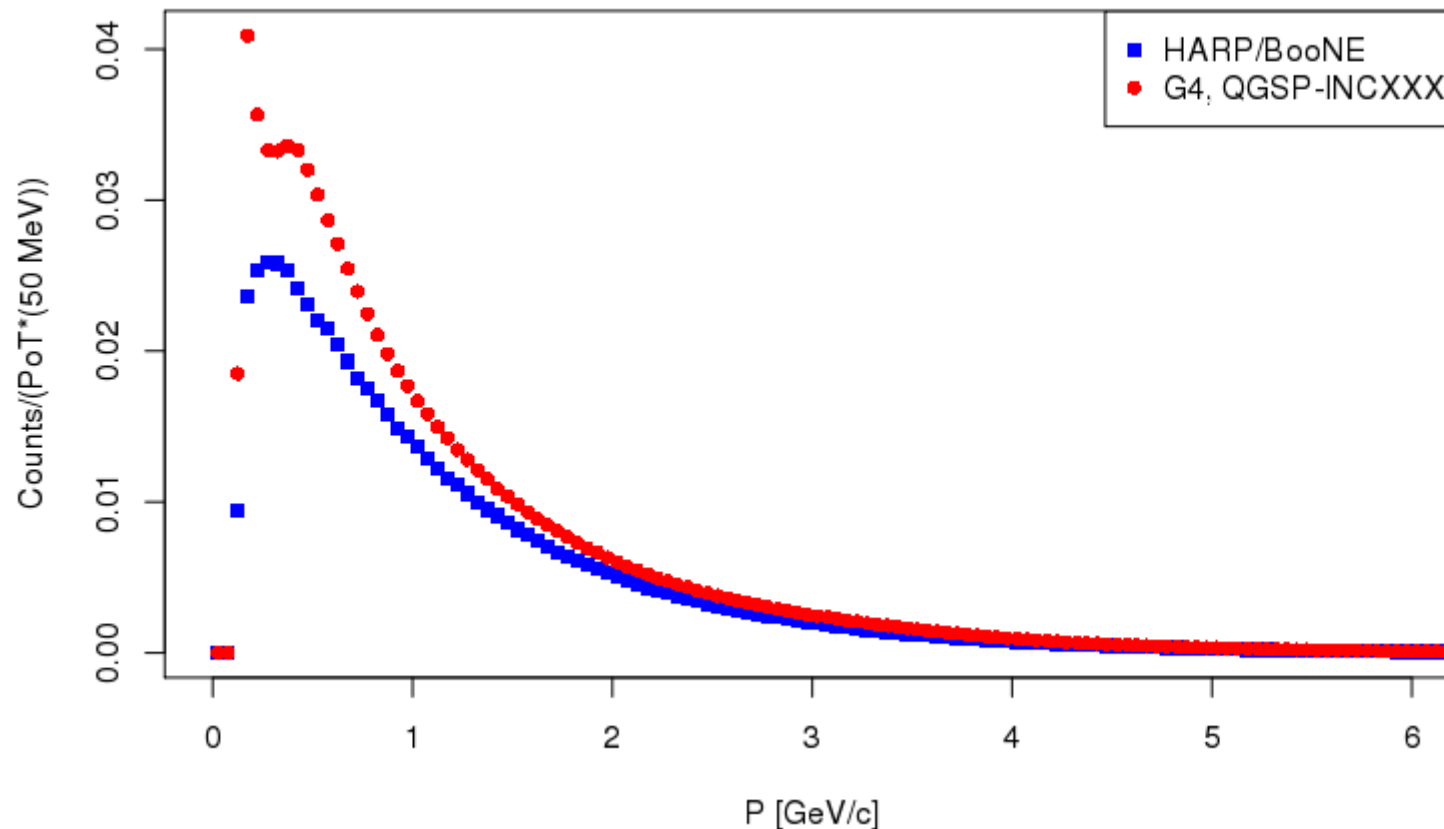
The version based on Geant v4.10.1.p03 also runs and produce a neutrino flux. However, the results are a bit distressing...

Neutrino flux, from $\pi^+ \rightarrow \mu^+ \nu_\mu$

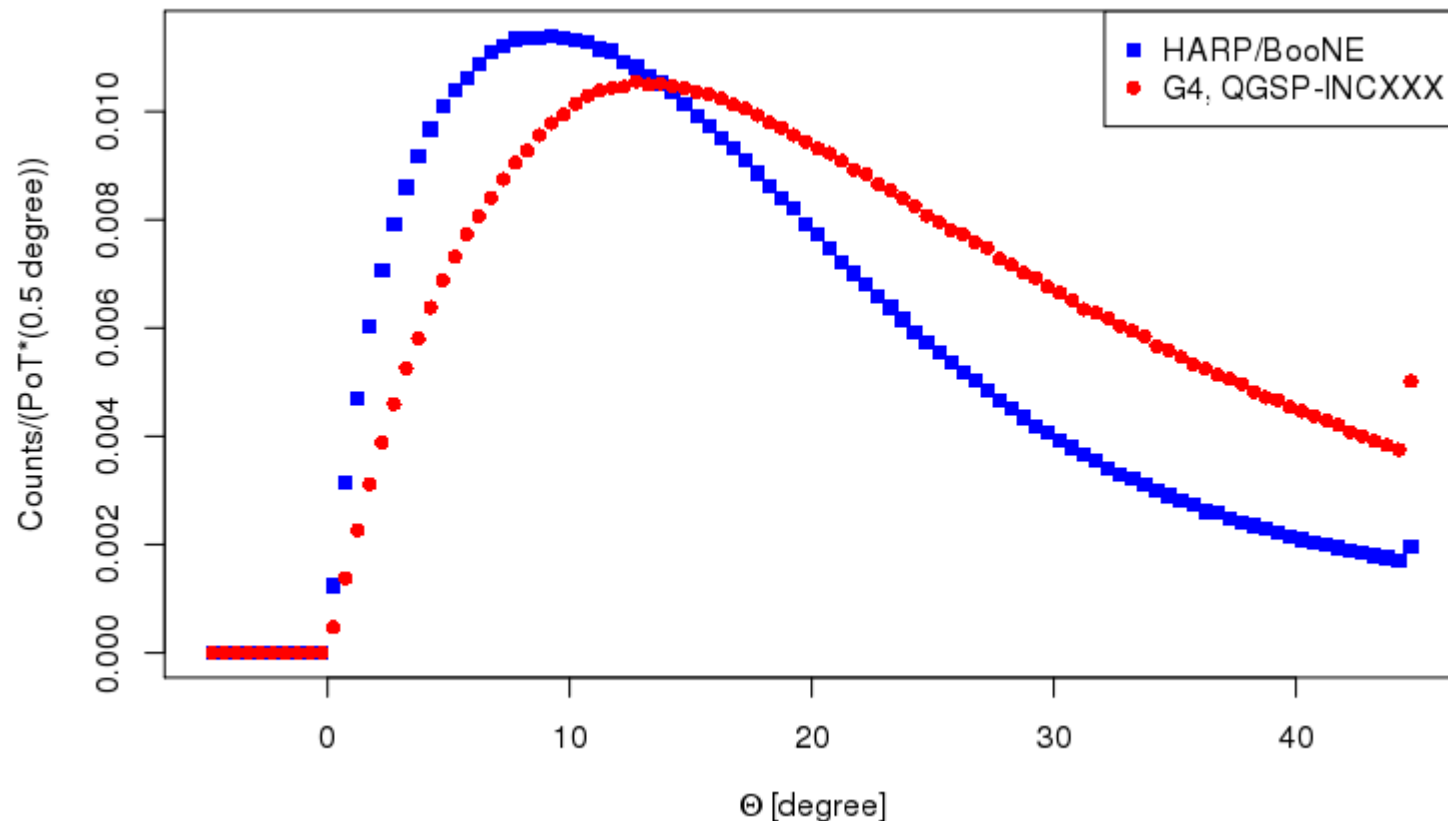The inelastic production of pions, proton on Be, seems quite a bit different, HARP/BooNE vs QSGSP_INCXX physics list.
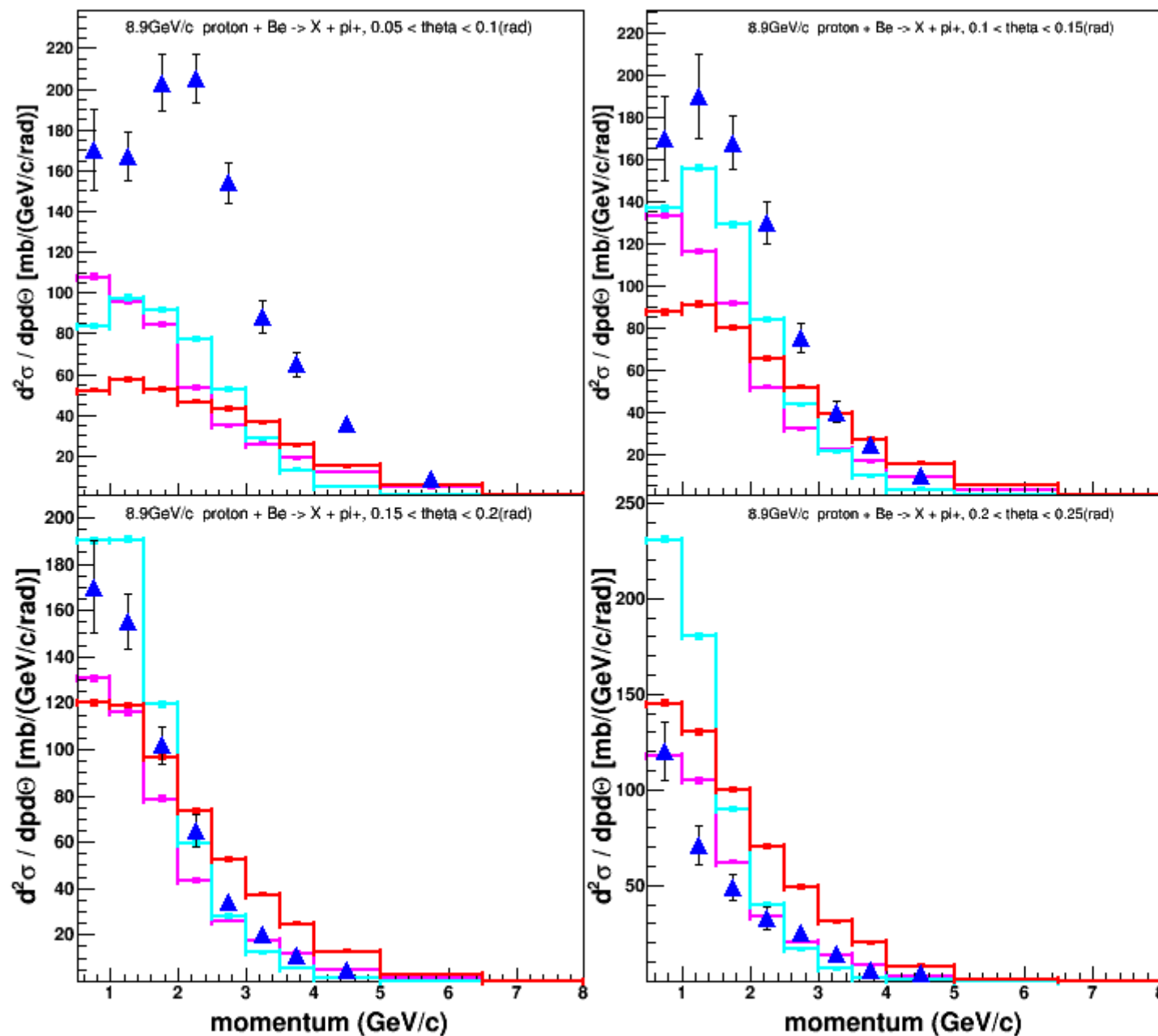
π^{+} From p → Be

Geant4 GQSP-INCXX (recommended, Hand W. et al) produced a lot more soft pions
So why do we have a deficit of neutrinos ?

Note: This is a bit disappointing.. I would have expected a better agreement...

π^+ From p $\rightarrow$ Be

The angular distribution differ even more.. Pions produced at large angle may be not be focused enough to go through the collimator.. And we have a serious deficit (almost a factor 2 at ~ 5 degrees) of pions in QGSP-INCXXX .

Received from Julia Yarba, April 14 2016.

She ran the same G4 version..

Note that the comparison starts at 50 mRad.

And the G4 MC deficit (for all physics list do show a severe deficiency.

Consistent with the previous slides.

MC vs HARP Data; χ^2/NDF calculated over FW theta bins
χ^2/NDF = 24.5871 for bertini
χ^2/NDF = 28.9052 for ftfp
χ^2/NDF = 43.5329 for inclxx

7

π^+ Yield After the Collimator...
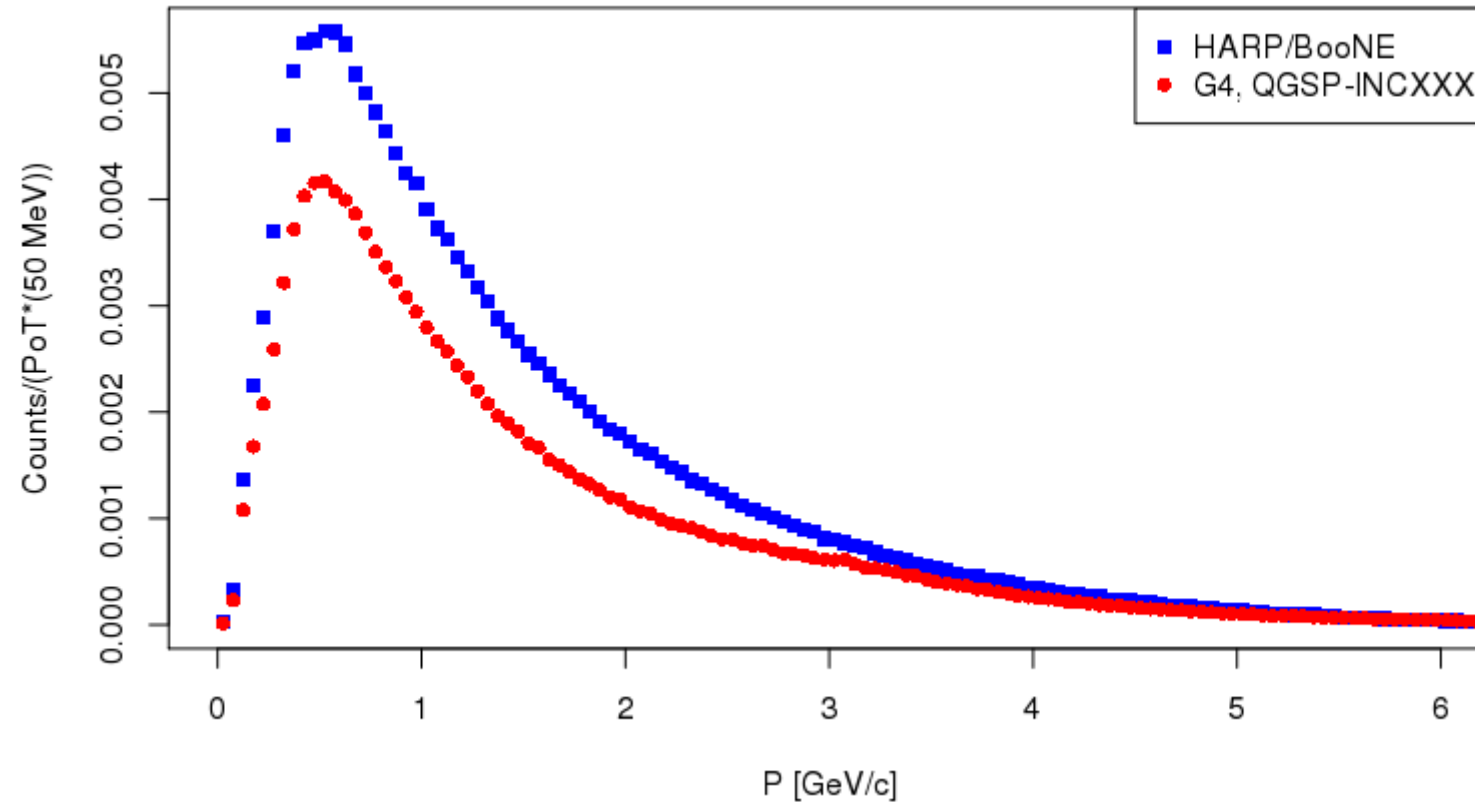
Consequently, we have a serious deficit of pion filtering through the collimator...

Back to the HARP/BooNE generator for 1rst generation of pions.

The Dk2nu ancestry has been ugraded to include both inelastic and elastic collisions, as these can induce significant change in the transverse momentum of the pion, thereby compromising proper focusing.

Ancestry Multiplicity
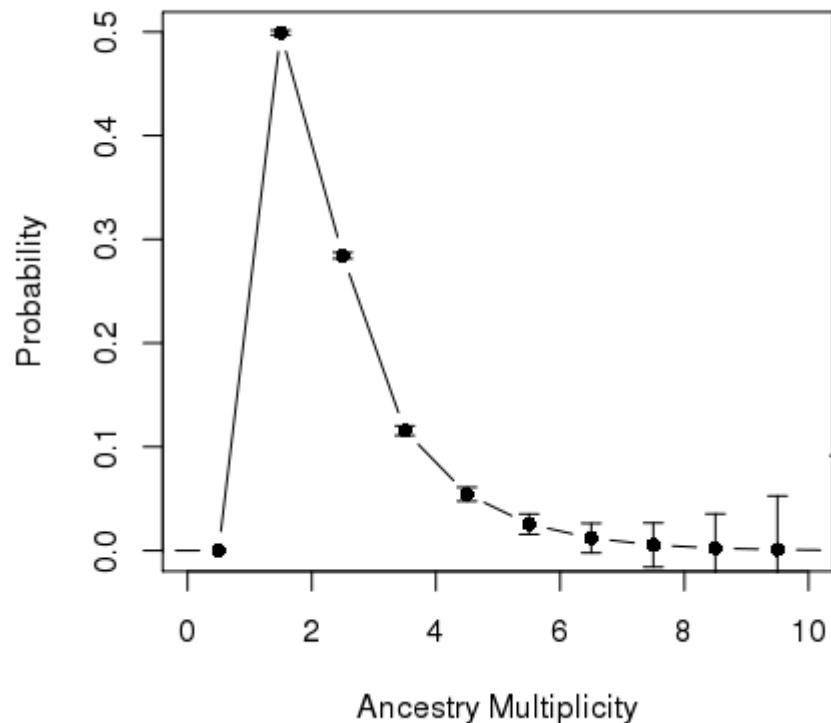
First, we select all the pions in the Dk2nu ntuple that are (I) Positively charged (ii) and will decay to $\mu^+ \nu_\mu$ Then, ask the depth of the ancestry tree of the oucoming neutrino. The minimum is 2, as the primary does not decay into a neutrino, but counts in the ancestry. These are the "easy" cases" proton comes in, create π^+ (HARP/BooNE) model, and this π^+ decays without scattering at all.

This is only 50% of the neutrinos that appear in the Dk2nu. Ntuple. This ancestry multiplicity is shown on the plot on the left.
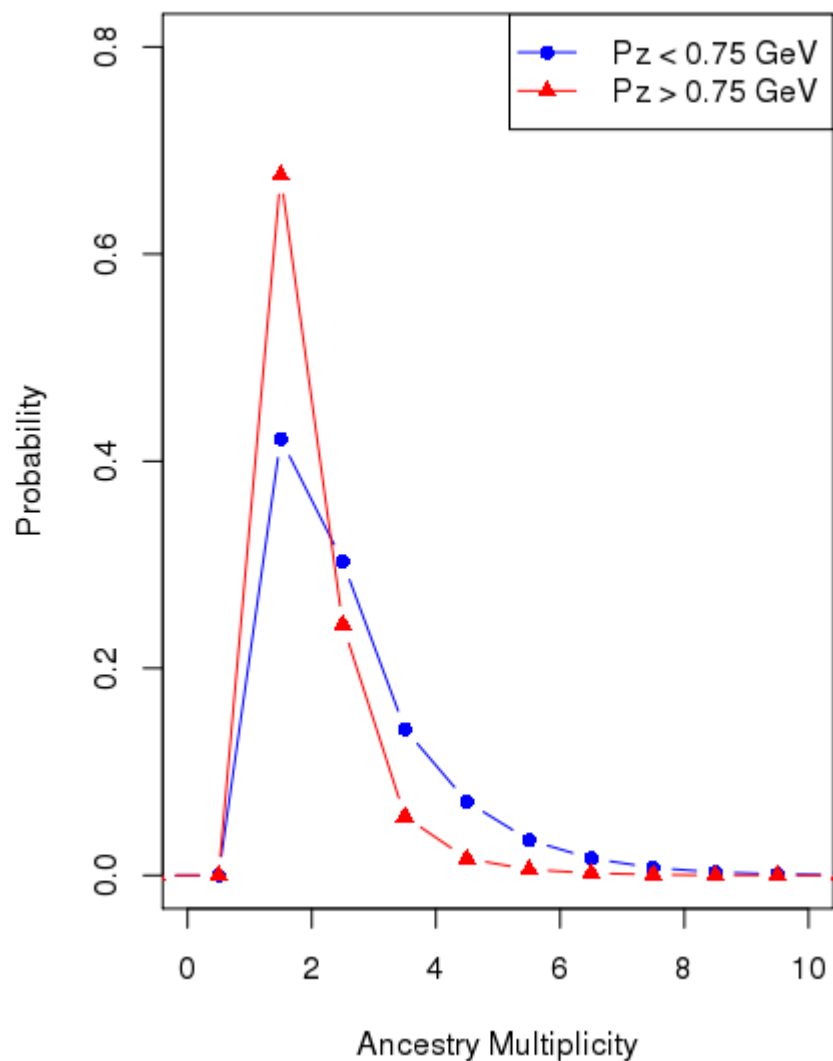
But, perhaps, it is only the wimpy pions that do scatter, and those are not likely to get enough boost to point towards the neutrino detector.

Actually, this what we see. But this effect is not large: we still have ~32% of the pion with large (> 0.75 GeV/c) that are subjected to secondary interactions.

For today ….